ACCESSION #: 9610170219

LICENSEE EVENT REPORT (LER)

FACILITY NAME: Arkansas Nuclear One - Unit PAGE: 1 OF 5

DOCKET NUMBER: 05000313

TITLE: Automatic Reactor Trip And Emergency Feedwater System

Actuation When Two Reactor Coolant Pump Motors De-

energized Due To A Defective Fuse In An Electrical Bus

Under Voltage Circuit

EVENT DATE: 09/12/96 LER #: 96-007-00 REPORT DATE: 10/10/96

OTHER FACILITIES INVOLVED: DOCKET NO: 05000

OPERATING MODE: N POWER LEVEL: 100

THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR SECTION:

50.73(a)(2)(iv)

LICENSEE CONTACT FOR THIS LER:

NAME: Thomas F. Scott, Nuclear Safety and

Licensing Specialist TELEPHONE: (501) 858-4623

COMPONENT FAILURE DESCRIPTION:

CAUSE: B SYSTEM: EA COMPONENT: FU MANUFACTURER: G080

B SJ CAP L200

REPORTABLE NPRDS: N

Y

SUPPLEMENTAL REPORT EXPECTED: X

ABSTRACT:

An automatic reactor trip was initiated when a non-vital 6.9 kV electrical bus providing power to two Reactor Coolant Pump (RCP) motors sensed an under voltage condition. A circuit breaker being racked down created vibration when its springs discharged causing the bus protection circuitry to open the RCP motor breakers. The root cause was a mechanical failure of a fuse in the bus protection circuitry. A defective solder joint between the element and end cap resulted in interruption of continuity. Following the trip, both trains of the Emergency Feedwater System actuated when water level in one Once Through Steam Generator reached the initiation setpoint. Level decrease was due to the associated main feedwater block valve not closing automatically because of a failed capacitor in the electrical clutch mechanism circuit. Because of the proximity to a scheduled refueling outage, the unit was not returned to power. A failure analysis of the defective fuse was performed by the fuse vendor. The defective fuse and the other one in the same fuse block were replaced. Repairs were completed for the main feedwater block valve and the redundant valve by replacing capacitors in the clutch control circuits.

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A. Plant Status

At the time of this event, Arkansas Nuclear One Unit I (ANO-1) was operating in normal steady-state conditions at approximately 100 percent power. Preparations to isolate Startup Transformer #2 were in progress.

B. Event Description

An automatic reactor trip occurred at 1210 on September 12, 1996, when protection circuitry for the electrical bus supplying two Reactor Coolant Pump (RCP) motors caused their breakers to open upon sensing an under voltage condition. Following the trip, the Emergency Feedwater System (EFW) [BA] automatically actuated on low water level in one Once Through Steam Generator (OTSG) [AB].

As part of the preparation to isolate Startup Transformer #2, a feeder circuit breaker designated H-13 was being racked down.

Breaker H-13 is the supply from the transformer to non-vital 6.9 kV electrical bus H-1. As the springs for H-13 discharged, vibration caused a defective fuse to lose continuity resulting in an under voltage condition being sensed by the H-1 bus protection circuitry while the bus was still energized. The H-1 bus under voltage protection circuitry functions to protect RCP motors "A" and "C" by tripping their breakers when an under voltage condition is detected. When the breakers for these motors tripped, the Reactor Protection System (RPS) [JC] caused the reactor to trip, as expected, due to neutron flux exceeding the allowable value for only two operating RCPs. Primary system response to the trip was normal for this event.

Following the reactor trip, the Main Feedwater (MFW) [SJ] block valve to the "B" OTSG did not close automatically. Normal post-trip response is for both MFW block valves to receive a signal to close in fast speed. The motor for the "B" MFW block valve was observed to be energized and turning without the valve closing. The block valve not closing resulted in "B" MFW pump controls being unable to prevent water level in "B" OTSG from reaching the EFW initiation set point. EFW automatically actuated both trains at 1221 and controlled OTSG level at the appropriate setpoint. The block valve was manually closed at 1229. OTSG level control was switched to Auxiliary Feedwater and EFW was secured at 1315.

A refueling outage had been scheduled to start on September 17, 1996. ANO management elected to begin the outage early instead of returning to power.

C. Root Cause

The root cause of the reactor trip was determined to be a defective fuse in a relay circuit for the H-1 bus. The purpose of the relay is to strip the H-1 bus in the event of a loss of voltage. The fuse was located in a plastic fuse block in the H-13 breaker cubicle. As the fuse block was being removed to investigate the cause of the trip, the H-1 bus under voltage condition cleared and then returned. Ohmmeter readings of the fuse were taken immediately after it was removed. Placing a slight mechanical stress on the fuse caused interruption of continuity readings. When the springs for H-13 discharged during the racking down process, the vibration caused a loss of continuity through the fuse that resulted in indication of an under voltage condition on the H-1 bus. To confirm that the fuse was defective and not blown, an inspection hole was cut into the barrel of the fuse. The white silica powder was removed, and the fuse element was exposed. It was found to be intact for the entire length of the fuse with no molten areas. The ends appeared to be connected to the end caps. Analysis of the fuse by the vendor concluded that the failure involved a defective solder joint

resulting in intermittent connection with the end cap. The failure was classified as "random/time related." The solder appeared to have heated and melted away from the element during the manufacturing process creating a defect that degraded with time in service. The fuse was manufactured in September 1969. The adjacent fuse removed from the same fuse block was also subjected to analysis, and there was no indication of failure.

The MFW block valves have a clutch between the motor and the valve that allows operation in either fast or slow speed. Following a reactor trip, the normal response is for the fast clutch to engage and the valve to close in fast speed for most of the stroke. The final travel to the seat occurs in slow speed via the slow speed clutch. The cause of the valve failing to close on September 12 was a capacitor across the low speed clutch coil that was found shorted to ground. The purpose of the capacitor is to suppress voltage spikes generated when the clutch is de-energized. The shorted capacitor blew a fuse when the coil was energized. There are two of these capacitors installed for each block valve. The other three capacitors that had not failed were tested with results indicating that they were deteriorated. The cause of the capacitor failure was attributed to exceeding its expected life.

MFW pump controls were evaluated to have functioned as designed following the trip. Normal response is for the Integrated Control

System (ICS) [JA] to reduce MFW pump speed to minimum, the block valve to close, and the interlock from the block valve to transfer pump control from flow to loop differential pressure control. When OTSG level drops below 45 inches, pump speed increases to establish a differential pressure across the startup feedwater valve. When level drops further, the startup feedwater valve opens to control OTSG level at approximately 30 inches. Following the September 12 trip, the block valve not closing resulted in the flow controller remaining selected for MFW pump control. When level dropped below 45 inches, pump speed remained at the minimum value due to a positive feedwater flow error (measured flow and OTSG level above setpoint). As level dropped below setpoint, the ICS

increased pump speed as expected, but speed increased too slowly to prevent EFW actuation because the NEW pump flow controller is tuned for flow rather than level control feedback. EFW raised OTSG level which drove MFW pump speed to minimum. When the block valve was manually closed, MFW pump speed increased to control differential pressure, as expected.

D. Corrective Actions

The defective fuse and the other one in the same fuse block were replaced to restore the H-1 bus to an operable status by 1630 on September 12, 1996. Following inspection and testing, both fuses

that had been removed were sent off-site for failure analysis.

Fuses from several electrical buses were removed during the outage and tested. No similar defects were discovered.

Both MFW block valve actuators and motor/clutch assemblies were inspected. No deterioration of the gear trains was found. Visual inspection of the clutches upon disassembly revealed no significant wear. Capacitors in both MFW block valve clutch circuits were replaced with equivalent components.

E. Safety Significance

The RPS initiated the reactor trip, and both trains of EFW actuated on low OTSG level, as designed. The post-trip response of primary systems was normal. The equipment deficiencies discussed above posed no significant challenge to the ability to maintain the plant in a safe shutdown condition. Neither bus H-1, the failed fuse, nor the main feedwater block valve actuator clutch provide functions required to safely shutdown the reactor or maintain it in a safe shutdown condition. Operator responses were accomplished with no significant complications. Therefore, this event is considered to be of minimal safety significance.

F. Basis for Reportability

The automatic reactor trip constituted an RPS actuation, and the EFW System actuation constituted actuation of an Engineered Safety Feature (ESF), both of which are reportable per

10CFR50.73(a)(2)(iv). A report was made to the NRC Operations Center at 1326 on September 12, 1996, in accordance with 10CFR50.72(b)(2)(ii).

G. Additional Information

There have been no similar events reported by ANO as Licensee Event Reports.

The fuse in the under voltage circuit for bus H-1 was a Model OT10 manufactured by the Gould Shawmut Division of Gould, Inc. (ANO-assigned manufacturer code G445X) and supplied by General Electric Company (manufacturer code G080). The fuse is constructed using a non-laminated paper cartridge with metal end caps crimped at each end. The fuse element is contained within the cartridge, soldered to the end caps, and protected with an inert silica powder filler material.

The capacitors in the MFW block valve clutch circuit were of the oil filled, rolled foil, bath tub construction with rating of 0.25 microfarad and 600 VDC. They were manufactured by Aerovox Inc. (ANO-assigned manufacturer code A105X) and supplied by Limitorque Corporation (manufacturer code L200) as part of the two-speed clutch for an SMB-4 actuator. The capacitors have no model number assigned and are not listed on the replacement parts list. The capacitors had "630" and "S04" or "S06" stamped on them, but the

significance of these markings could not be identified by the

manufacturer

Energy Industry Identification System (EIIS) codes are identified in

the text as [XX].

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ENTERGY

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October 10, 1996

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U. S. Nuclear Regulatory Commission

Document Control Desk

Mail Station P1-137

Washington, DC 20555

Subject: Arkansas Nuclear One - Unit 1

Docket No. 50-313

License No. DPR-51

Licensee Event Report 50-313/96-007-00

Gentlemen:

In accordance with 10CFR50.73(a)(2)(iv), enclosed is the subject report

concerning an automatic reactor trip and initiation of the Emergency

Feedwater System.

Very truly yours,

Dwight C. Mims

Director, Nuclear Safety

DCM/tfs

enclosure

U.S. NRC

October 10, 1996

cc: Mr. Leonard J. Callan

Regional Administrator

U. S. Nuclear Regulatory Commission

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